

1 **Amendments to the Claims**

2  
3 Claim 1 (canceled): Apparatus for controlling the polarization of an incident beam of  
4 electromagnetic radiation comprising:

5 photonic crystal means, and  
6 means for directing said incident beam of electromagnetic radiation at said  
7 photonic crystal means,

8 wherein said photonic crystal means comprises a crystalline lattice having cells  
9 with a defined periodic geometry that produces a polarization-dependent band structure by  
10 interference between Bragg reflections from many material interfaces for electromagnetic  
11 radiation.

12  
13 Claim 2 (canceled): The apparatus of claim 1 wherein said beam propagates in the  
14 plane of periodicity of a two-dimensional (2D) photonic crystal.

15  
16 Claim 3 (canceled): The apparatus of claim 1 wherein said beam propagates in any  
17 direction in a three-dimensional (3D) photonic crystal.

18  
19 Claim 4 (canceled): The apparatus of claim 1 wherein said beam is a polarized beam  
20 of EM radiation and wherein said photonic crystal means includes a transparent spectral  
21 region at a lower frequency than the fundamental band gap or between two band gaps, and  
22 that portion of said beam in said transparent spectral region is transmitted through the crystal  
23 and the polarization of said transmitted beam is altered by said photonic crystal means,  
24 whereby said crystal functions as a waveplate.

1 Claim 5 (currently amended): ~~The apparatus of claim 4~~ Apparatus for controlling the  
2 polarization of an incident beam of electromagnetic radiation comprising:

3 photonic crystal means, and  
4 means for directing said incident beam of electromagnetic radiation at said  
5 photonic crystal means,

6 wherein said photonic crystal means comprises a crystalline lattice having cells  
7 with a defined periodic geometry that produces a polarization-dependent band structure by  
8 interference between Bragg reflections from many material interfaces for electromagnetic  
9 radiation, and wherein that a portion of said beam having said first wavelength is  
10 exponentially attenuated by said photonic crystal means and is reflected so that said  
11 apparatus functions as a reflection waveplate.

12  
13 Claim 6 (currently amended): ~~The apparatus of claim 4~~ Apparatus for controlling the  
14 polarization of an incident beam of electromagnetic radiation comprising:

15 photonic crystal means, and  
16 means for directing said incident beam of electromagnetic radiation at said  
17 photonic crystal means,

18 wherein said photonic crystal means comprises a crystalline lattice having cells  
19 with a defined periodic geometry that produces a polarization-dependent band structure by  
20 interference between Bragg reflections from many material interfaces for electromagnetic  
21 radiation, and wherein said incident beam of EM radiation includes first and second  
22 polarization components, and wherein said photonic crystal means reflects said first  
23 polarization component and transmits said second polarization component, thereby functioning  
24 as a polarizer.

1 Claim 7 (currently amended): The apparatus of claim 5 wherein a portion of said  
2 incident beam is transmitted through said crystal, and wherein said transmitted beam and said  
3 and reflected portions of said incident beam can have any angle relative to said incident beam,  
4 whereby said apparatus is not limited by Brewster's angle.

5  
6 Claim 8 (currently amended): An apparatus for maximizing conversion efficiency in  
7 nonlinear optical mixing processes between incoming, polarized optical beams and output,  
8 polarized optical beams comprising:

9 birefringent photonic crystal means composed of material with optical  
10 nonlinearity for achieving phase matching of said output beams with said incoming beams,  
11 wherein said birefringent photonic crystal means is adapted to reduce the wavevector  
12 mismatch  $\Delta k$  between said incoming and output beams to zero using said photonic crystal  
13 birefringence, ~~and wherein said birefringent photonic crystal means is adapted to achieve~~  
14 ~~phase matching without the use of or minimal use of angle tuning or temperature tuning.~~

15  
16 Claim 9 (canceled)

17  
18 Claim 10 (canceled)

19  
20 Claim 11 (original): The apparatus of claim 8 wherein said photonic crystal means is  
21 composed of material which is not naturally birefringent.

22  
23 Claim 12 (canceled)

1        Claim 13 (canceled): An optical apparatus for selectively changing a first known  
2 polarization of an input beam to a second, predetermined polarization of an output beam,  
3 comprising:

4                a photonic crystal means, and  
5                means for directing said input beam at said photonic crystal means,  
6                wherein said photonic crystal means comprises a crystalline lattice having cells  
7 with a defined periodic geometry that produces a band structure by interference between  
8 Bragg reflections from many material interfaces for electromagnetic waves.

9  
10        Claim 14 (canceled): A method of converting the polarization of an incoming beam of  
11 light from a first, known polarization to a second, selected polarization, comprising the steps:  
12                directing said incoming beam of light along a predetermined path,  
13                causing said incoming beam to enter a photonic crystal wherein said photonic  
14 crystal is adapted to convert said first polarization to said second polarization, and  
15                causing a beam of said second selected polarization to either be transmitted  
16 through or reflected off of said photonic crystal.

1 Claim 15 (original):-- An optical apparatus for creating a delay line arising from a  
2 transfer of energy between two different polarizations of electromagnetic (EM) waves,  
3 comprising:

4 birefringent crystal means,  
5 polarizer means in series with said birefringent crystal means, and  
6 means for directing said EM wave through said birefringent crystal means and  
7 said polarizer means,

8 wherein either a delayed or advanced transmitted electromagnetic waveform or  
9 wavepacket results by adjusting either the relative angular orientations of said birefringent  
10 crystal means, said polarizer means, and/or said incident EM wave polarization.

11  
12 Claim 16: (new) The apparatus of claim 8 wherein said photonic crystal means is  
13 adapted to achieve phase matching without the use of or minimal use of angle tuning or  
14 temperature tuning.

15  
16 Claim 17: (new) The apparatus of claim 8 wherein said polarized input beam has  
17 frequency  $w_1$  and first wavevector  $k_1$ , and said polarized output beam has frequency  $w_2$  and  
18 second wavevector  $k_2$ , wherein said photonic crystal is adapted to reduce the wavevector  
19 mismatch between input and output beams to zero.

20  
21 Claim 18: (new) The apparatus of claim 8 wherein said photonic crystal means is  
22 adapted to eliminate the walk-off of ordinary and extraordinary waves characteristic of phase  
23 matching with angle tuning.